ACTUATOR

BACKGROUND OF THE INVENTION

[1] The present invention relates to actuators, in particular power actuators for operating lock mechanisms of vehicle doors and other closures.

[2] Such power operated lock mechanisms commonly form part of a central locking system of the vehicle whereby locking or unlocking of some or all doors or other closures can be effected from a single control station actuated from within or outside the vehicle as by a coded infra red or other remote input device. The lock mechanism and associated power actuator will provide for manual operation whereby respective doors can be locked and unlocked using a conventional internal sill button or other manually operated input element, and, maybe by manual operation of a cylinder or key controlled exterior lock.

SUMMARY OF THE INVENTION

[3] An object of the present invention is to provide an improved form of actuator.

[4] Thus according to the present invention there is provided an actuator including a rotatable worm wheel reversibly drivable by a motor, the worm wheel being operably connectable to an output element by a drive transfer device, the output element being moveable between a first and second position, in which the drive transfer device is operably disconnectable from the output lever to allow independent movement of the output lever.

[5] According to another aspect of the present invention there is provided an actuator including a gear wheel being rotatable relative to a chassis of the actuator and being reversibly drivable by a motor, the gear wheel being operably connectable to an output element by a drive transfer device, the output element being moveable between a first and second position, the output element acting to move a stop device between a corresponding first and second position, in which the stop device acts to stop the motor.

[6] According to another aspect of the present invention there is provided an actuator including a rotatable gear wheel reversibly drivable by a motor, the gear wheel being

operably connectable to an output element by a drive transfer device, the output element being moveable between a first and second position, in which a stop device operates on forwards and reverse gear wheel stop to stop the motor, in a forwards and reverse direction, the stop device including a forwards stop device stop resiliently moveable relative to a reverse stop device stop to allow the forwards gear wheel stop to pass the reverse stop device stop and to allow the reverse gear wheel stop to pass the forwards stop device stop.

BRIEF DESCRIPTION OF THE DRAWINGS

[7] The invention will now be described, by way of example only with reference to the accompanying drawings in which:

[8] Figure 1 an exploded isometric view of part of an actuator according to the present invention;

[9] Figures 2 to 12 are partial plan views of the actuator of figure 1;

[10] Figures 13 to 15 are partial side elevation views of the actuator figure 1;

[11] Figure 16 shows the extent of movement of various components of the actuator of figure 1; and

[12] Figure 17 shows this drive transfer device of figure 1.

DETAILED DESCRIPTION OF THE DRAWINGS

[13] With reference to figure 1 there is shown an actuator 10 having a housing 12, a gear wheel, in this case a worm wheel 14, a stop device 16, a drive transfer device 18 and an output element 20.

[14] Actuator 10 further includes a motor (not shown) having an output shaft (not shown) upon which is mounted a pinion (not shown) for engagement with the periphery 14A of the worm wheel 14.

[15] Housing 12 includes a motor recess 22 in which sits the motor, and a worm wheel recess 24 in which sits the worm wheel 14.

[16] Within the worm wheel recess is a first pivot pin 26. Furthermore the worm wheel recess includes first ramp 28 and second ramp 30 which are connected by plateau 32.

[17] Housing 12 further includes a second pivot pin 34.

[18] Worm wheel 14 includes a tooth periphery 14a (teeth of which are not shown for clarity).

[19] Worm wheel further includes boss 36 having abutments 38 and 40 (also known as reverse gear wheel stop and forwards gear wheel stop).

[20] A recess 42 is provided in a lower portion of the worm wheel and a hole 44 provides communication between the upper surface of the boss 36 and the recess 42.

[21] The worm wheel further includes a central hole 46 in which is the positioned first pivot pin 26 to allow the worm wheel to rotate within the worm wheel recess 24.

[22] Stop device 16 includes first arm 48 and second arm 50.

[23] A forwards stop abutment 48A (also known as a forwards stop device stop) is provided on the end of first arm 48 and a reverse stop abutment 50A (also known as a reverse stop device stop) is provided on the end of second arm 50.

[24] Stop device 16 includes a hole 52 for mounting on second pivot pin 34 to allow the stop device to pivot about second pivot pin 34.

[25] A slot 54 is provided between the first and second arms and runs from the hole 52 in the general direction of the first pivot pin 26.

[26] The stop device 16 is made from a resilient material and the slot 54 allows the forward stop abutment 48A to move slightly relative to reverse stop abutment 50A (see especially figure 7) wherein the slot 54 has opened slightly when compared with say figure 6.

[27] The output element 20 includes a central hole 56 for pivotally mounting the output element on the first pivot pin 26.

[28] The output element 20 further includes a first arm 58 which terminates in abutment 60 and a second arm 62 which includes a recess 64 and first and second ramps 66 and 68.

[29] The drive transfer device 18 (shown schematically in figure 1, though in more detail in figure 17) includes a pin 70 having a lower shoulder 72 contained within pin housing 74. The drive transfer device 18 further includes a first spring 76 also contained within pin housing 74 and a second spring 78 mounted around the pin and within recess 42. It can be seen that the second spring 78 acts on pin housing 74 which in turn acts on shoulder 72 to bias the pin 70 downwards (when viewing figure 14) relative to the worm wheel. Furthermore the first spring 76 acts on a lower portion of the pin housing to bias the pin 70 upwards towards the output element 20 (see especially figure 15).

[30] Operation of the actuator is as follows.

[31] Consideration of figure 2 shows that the output element 20 at position B whilst abutment 38 of the worm wheel rest upon reverse stop abutment 50A of the stop device 16. In this position the drive transfer device 18 is aligned with recess base 24A thus allowing both the first spring 76 and second spring 78 to become extended (see for example figure 14). As such pin head 70A sits below the output element 20.

[32] Actuation of the motor causes the worm wheel to move in a forwards (clockwise) direction when viewing figure 2, progressively through the position shown in figure 13, figure 3, figure 14, figure 4 to the position shown in figure 5.

[33] It should be noted that the forwards and reverse directions of the motor have been chosen arbitrarily simply for ease of understanding of the invention.

[34] Consideration of figure 13 shows that the worm wheel has rotated, carrying with it the drive transfer device, such that the pin housing 74 is caused to ride up second ramp 30 which results in second spring 78 becoming compressed and pin head 70 entering recess 64 of the output element 20.

[35] It should be noted that the drive transfer device is moved at a predetermined position of the worm wheel relative to the chassis of the actuator, i.e. when the drive

transfer device engages the ramp. Furthermore, during this powered operation only second spring 78 is compressed and thus the drive transfer device acts in a first resilient mode.

[36] Consideration of figure 3 shows that pin 70A has contacted an edge of recess 64 resulting in the drive transfer device 18 transferring the rotational movement of the worm wheel 14 to the output element 20. Note that output element 20 has moved in a clockwise direction from position B.

[37] During this movement a lower edge of the pin housing 74 slides along plateau 32 thus ensuring that pinhead 70A is maintained in recess 64.

[38] Consideration of figures 14 and 4 show different views of the actuator in the same position. It should be noted that pin housing has moved from plateau 32 down first ramp 28 and is opposite recess base 24a. This allows first spring 76 to extend thus lowering pin head 70A from within recess 64 and disengaging drive between the worm wheel and the output element. The first ramp 28 is arranged such that the output element 20 is rotated to position A, but no further. In this position abutment 60 of output element 20 has contacted the end of second arm 50 of the stop device causing it to rotate slightly in an anticlockwise direction (compare figure 2 and figure 4).

[39] Continued operation of the motor causes the worm wheel alone to rotate to the position as shown in figure 5 whereupon abutment 40 contacts forward stop abutment 48A which stops the motor by causing it to stall momentarily until the power to the motor is stopped. Note that forwards stop abutment 48A acts as a substantially rigid stop since arm 48 does not compress. However, in further embodiments it would be possible to put in a degree of resilience to the system such that the gear wheel is stopped progressively.

[40] By driving the motor in a reverse direction the worm wheel 14, stop device 16, drive transfer device 18 and output element 20 can be returned to the position as shown in figure 2.

[41] However, starting at the position shown in figure 5, it is also possible to manually move the output element 20 anticlockwise from position A as shown in figure 5 to

position B as shown in figure 6, since at no time during this movement does pin head 70A engage recess 64.

[42] Where power operation is required to move the output element 20 from position B to position A, the motor is actuated to drive the worm wheel in the clockwise direction. In particular consideration of such powered movement from position shown in figure 6 to the position shown in figure 7 shows that during this time the drive transfer device is always opposite recess base 24A and hence pin head 70A is in a lowered position and can pass under first arm 58 of output element 20.

[43] Continued clockwise movement of the worm wheel causes abutment 40 (forwards gear wheel stop) and the radially outer edge 36a to move past the end of second arm 50 and in particular past reverse stop abutment 50A, causing the second arm 50 to spring radially outwards in doing so. Note that as shown in figure 7 the end of first arm 48 cannot move radially inwards since it is prevented from doing so by abutment 60 of the output element 20.

[44] Continued clockwise movement of the worm wheel through the position shown in figure 8 to the position shown in figure 9 moves the output element to position A. Note that the position shown in figure 8 is identical to the position shown in figure 3 and the position shown in figure 9 is identical to the position shown in figure 5.

[45] Consideration of the sequence of figures 5-9 shows that the worm wheel has only been driven in a clockwise direction (figures 7,8, and 9) but that the output lever is manually moved from the position shown in figure 5 to the position shown in figure 6. Thus by alternate manual and power operation it can be seen that the worm wheel only rotates in one direction and in particular the worm wheel rotates through 360° for every manual/powered sequence as shown in figures 5-9. Thus, if required, the worm wheel can be operated in such a manner that it continually rotates in the same direction.

[46] Consideration of figure 10 shows the output element 20 in position B (in fact the position shown in figure 10 is identical to the position shown in figure 2).

[47] Whilst it is possible to manually move the output element 20 from position B to position A as described above it is also possible to move the output element 22 to a position intermediate position A and B (see figure 11).

[48] Subsequent powered operation of the worm wheel in a forward direction (clockwise when viewing figure 12) causes the pin housing 74 to ride up second ramp 30 resulting in pin head 70A progressively projecting from the top surface from boss 36. However, because the output element 20 has been moved to an intermediate position pin head 70A rises outside recess 64. However, continued rotation of the worm wheel causes pin head 70A to engage first ramp 66 which results in a camming action forcing pin head 70A downwards and compressing first spring 76 (in a second resilient mode of operation of the drive transfer device) until such time as pin head 70A aligns with recess 64 whereupon first spring 76 can expand and push pin head 70A into recess 64, and this is in spite of fact that pin housing 74 is on plateau 32.

[49] Thus even when the output element is manually moved to an intermediate position the actuator can still function properly and does not jam.

[50] Considering of figure 16 shows the output element 20 in its extreme positions.

[51] The foregoing description is only exemplary of the principles of the invention. Many modifications and variations of the present invention are possible in light of the above teachings. The preferred embodiments of this invention have been disclosed, however, so that one of ordinary skill in the art would recognize that certain modifications would come within the scope of this invention. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specially described. For that reason the following claims should be studied to determine the true scope and content of this invention.